CONCRETE II

COURSE DESCRIPTION

Concrete II **is a course in which students will learn and practice intermediate skills related to reinforced concrete construction in residential and commercial structures. Topics covered include safe practices, advanced construction drawing interpretation and site layout, lightweight concrete, design of concrete mixes, design of reinforced concrete members. This course gives students a substantial skill and knowledge foundation typically required for apprentice concrete artisans.**

Prerequisite(s):	Concrete I, Algebra I or Math for Technology II Geometry, Principles of Technology I or Physical Science (may be concurrent)
Recommended Credits:	1
Recommended Grade Level(s):	12^{th}

CONCRETE II STANDARDS

1.0 Students will demonstrate leadership, citizenship, and teamwork skills required for success in the school, community, and workplace.

2.0 Students will take personal responsibility for the safety of themselves, their coworkers, and bystanders.

3.0 Students will interpret, lay out, and fabricate in conformance to construction drawings and written specifications.

4.0 Students will investigate the types, properties, and uses of lightweight concrete.

5.0 Students will design and test concrete mixes to meet specifications.

6.0 Students will demonstrate construction site layout requiring radial measurements and curvilinear boundaries.

7.0 Students will design common reinforced concrete structural members.

8.0 Students will describe basic troubleshooting methodologies for identifying and remedying concrete defects.

9.0 Students will describe common surface defects and demonstrate ways to repair them.

CONCRETE II

STANDARD 1.0

Students will demonstrate leadership, citizenship, and teamwork skills required for success in the school, community, and workplace.

LEARNING EXPECTATIONS

The student will:

1.1 Demonstrate leadership skills.
1.2 Use problem-solving techniques to address and propose solutions to school, community, and workplace problems.
1.3 Demonstrate the ability to work professionally with others.
1.4 Participate in SkillsUSA-VICA as an integral part of instruction.

PERFORMANCE STANDARDS: EVIDENCE STANDARD IS MET

The student:

1.1.A Exhibits integrity and pride in workmanship.
1.1.B Keeps group work focused on task.
1.2.A Determines the root causes of observed conflicts or problems.
1.2.B Mediates disputes between parties.
1.3.A Participates in a job shadowing experience.
1.3.B Assembles a student team to solve an assigned problem.
1.4.A Attends and participates in periodic meetings of SkillsUSA-VICA or similar organization.

SAMPLE PERFORMANCE TASKS

- Prepare a resume.
- Participate in various SkillsUSA-VICA or similar programs and/or competitive events.
- Attend a professional organization meeting such as, local Chamber of Commerce meeting.
- Participate in the American Spirit Award competition with SkillsUSA-VICA.
- Participate in job shadowing or internship program with local business or industry.
- Take an active role in a group project assigned by the instructor.
- Identify and detail a problem area in the school, community, or workplace, and propose solutions. If possible, and with appropriate approvals, implement or facilitate the solution.

INTEGRATION LINKAGES

SkillsUSA-VICA, *Professional Development Program,* SkillsUSA-VICA, Communication and Writing Skills, Teambuilding Skills, Research, Language Arts, Sociology, Psychology, Math, Math for Technology, Applied Communication, Social Studies, Problem Solving, Interpersonal Skills, Employability Skills, Critical-Thinking Skills, SCANS (Secretary's Commission on Achieving Necessary Skills), Chamber of Commerce, Colleges, Universities, Technology Centers, and Employment Agencies

CONCRETE II

STANDARD 2.0

Students will take personal responsibility for the safety of themselves, their coworkers, and bystanders.

LEARNING EXPECTATIONS

The student will:

2.1 Exhibit and encourage in others a positive attitude regarding safety practices and issues.
2.2 Habitually inspect and use appropriate personal protective equipment for assigned tasks.
2.3 Inspect, maintain, and employ safe operating procedures with tools and equipment, such as welding equipment, lifting equipment, and power finishing equipment.
2.4 Exhibit a well-developed awareness of potential hazards to themselves and others.
2.5 Carry out responsibilities under HazCom (Hazard Communication) regulations.
2.6 Take action to protect coworkers and bystanders from hazards as required by regulations, and company policies.
2.7 Report accidents and observed hazards and execute emergency response procedures as required by regulations and company policies.
2.8 Demonstrate appropriate construction-related safety procedures.

PERFORMANCE STANDARDS: EVIDENCE STANDARD IS MET

The student:

2.1.A Includes safety procedures in activity plans.
2.1.B Exhibits an awareness of proper safety procedures by coworkers.
2.1.C Responds positively to instruction, advice, and correction regarding safety issues.
2.1.D Reports to school or work physically ready to perform to professional standards, such as rested, or not impaired by medications, drugs, alcohol, etc.
2.2.A Selects, inspects, and uses the correct personal protective equipment for the assigned task.
2.3.A Checks welding torches for leaks, prior to use.
2.3.B Inspects extension cords for the presence of a functional ground connection, prior to use.
2.4.A Is observant of personnel and activities in the vicinity of their work area.
2.4.B Warns nearby personnel, prior to starting potentially hazardous actions.
2.5.A Applies information from MSDSs (material safety data sheets) to protect self and others from the health hazards associated with assigned tasks.
2.5.B Reports hazards found on the job site to the supervisor and remedies the hazard as instructed.
2.6.A Provides and activates adequate ventilation equipment as required by the task.
2.7.A Reports all injuries and observed unguarded hazards to the immediate supervisor.
2.7.B Executes assigned tasks as described in emergency response procedures.
2.8.A Passes with 100 % accuracy a written examination relating to safety issues.
2.8.B Passes with 100% accuracy a performance examination relating to safety.
2.8.C Maintains a portfolio record of written safety examinations and equipment examinations for which the student has passed an operational checkout by the instructor.

SAMPLE PERFORMANCE TASKS

- Prior to assigning a task using power tools, the instructor removes some required safety items and instructs students to perform an inspection of tools.
- Instruct a visitor to obviously approach the vicinity of a student conducting a hazardous activity and note the level of awareness demonstrated by the student.
- In a project requiring solvents or adhesives, introduce a new brand or type, and require students to retrieve the MSDS and identify possible health hazards.

INTEGRATION LINKAGES

Science, Computer Skills, Research and Writing Skills, Language Arts, Communication Skills, Leadership Skills, Teamwork Skills, Math for Technology, Applied Communication, Applied Mathematics, Secretary's Commission on Achieving Necessary Skills (SCANS), Skills USA-VICA, Associated Builders and Contractors (ABC), Associated General Contractors (AGC), National Center for Construction Education and Research (NCCER), Occupational Safety and Health Administration (OSHA), Environmental Protection Agency, United States Department of Labor, Tennessee Department of Labor and Workforce Development, International Brotherhood of Electrical Workers, Plumbing, Heating, and Cooling Contractors (PHCC), Air Conditioning and Refrigeration Institute (ARI), American Society of Heating, Refrigeration and Air Conditioning Engineers, ASHRAE), Air Conditioning Contractors of America (ACCA), Refrigeration Service Engineers Society (RSES).
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CONCRETE II

STANDARD 3.0

Students will interpret, lay out, and fabricate in conformance to construction drawings and written specifications.

LEARNING EXPECTATIONS

The student will:

3.1 Scale dimensions that are not explicitly included in construction drawings.
3.2 Interpret plan and elevation views shown in construction drawings.
3.3 Recognize and correctly interpret lines and symbols commonly used in construction drawings.

PERFORMANCE STANDARDS: EVIDENCE STANDARD IS MET

The student:

3.1.A Uses the scale of a drawing to determine locations not explicitly dimensioned.
3.1.B Uses the scale of a drawing to determine dimensions not explicitly shown on drawing.
3.2.A Interprets three-dimensional features found in construction drawings.
3.3.A Readily relates structural concrete components and joints with symbols and concrete details in construction drawings.
3.3.B Interprets object lines, dimension and extension lines, center lines, section lines, and other lines commonly found in construction drawings.
3.3.C Readily relates symbols and details of framing, electrical, and plumbing elements that effect or could be affected by concrete decisions.

SAMPLE PERFORMANCE TASKS

- Given a set of plans and specifications for a residential or commercial structure, make a complete material take-off for the concrete components.
- Given a set of plans and specifications for a residential or commercial structure, determine the location of concrete elements not explicitly dimensioned.
- Determine the detail of specified routing and structural supports for conduit or piping runs through masonry structures shown in construction drawings.
- Given a set of plans and specifications for a residential or commercial structure, determine the location of elements not explicitly dimensioned.

INTEGRATION LINKAGES

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CONCRETE II

STANDARD 4.0

Students will investigate the types, properties, and uses of lightweight concrete.

LEARNING EXPECTATIONS

The student will:

4.1 Research lightweight aggregates for concrete.
4.2 Compare and contrast lightweight aggregates, designs, and processes for roof and floor decks and walkways.
4.3 Design and construct test panels using lightweight concrete as one component of a composite.

PERFORMANCE STANDARDS: EVIDENCE STANDARD IS MET

The student:

4.1.A Compares cost and performance of available natural and manufactured lightweight aggregates.
4.1.B Researches and reports on the lightweight concrete systems favored by local architects and builders.
4.2.A Compares and contrasts the insulation values for different lightweight concrete mixtures.
4.2.B Compares and contrasts methods of providing structural strength in lightweight concrete decks.
4.2.C Compares and contrasts the cost and availability of various lightweight concrete aggregates.
4.3.A Designs and constructs composite lightweight concrete roof or floor panels that take advantage of the compressive strength of the concrete.
4.3.B Designs and constructs composite lightweight concrete systems that are optimized for insulation and installed cost.

SAMPLE PERFORMANCE TASKS

- Construct demonstration panels for a composite lightweight concrete application as shown in construction drawings of a commercial building.
- Take a field trip to observe the construction of lightweight concrete decks.
- Survey current and planned local commercial construction projects to determine what uses are being made of lightweight concrete.

INTEGRATION LINKAGES

Science, Computer Skills, Research and Writing Skills, Language Arts, Communication Skills, Leadership Skills, Teamwork Skills, Applied Communication, Algebra, Geometry, Secretary's Commission on Achieving Necessary Skills (SCANS), Skills USA-VICA, Associated Builders and Contractors (ABC), Associated General Contractors (AGC), National Center for Construction Education and Research (NCCER), Occupational Safety and Health Administration (OSHA), Environmental Protection Agency, United States Department of Labor, Tennessee Department of Labor and Workforce Development

CONCRETE II

STANDARD 5.0

Students will design and test concrete mixes to meet specifications.

LEARNING EXPECTATIONS

The student will:

5.1 Design concrete mixes to meet specifications.
5.2 Select aggregate from available sources and adapt concrete mixes to meet specifications.
5.3 Calculate weights of components required to produce test samples of given concrete mix design.
5.4 Cast, cure, and test concrete samples and compare with performance specifications.

PERFORMANCE STANDARDS: EVIDENCE STANDARD IS MET

The student:

5.1.A Determines water to cement ratios to produce desired compressive strength.
5.1.B Determines aggregate proportions to meet specifications.
5.2.A Determines sizes, densities, and costs of available aggregates.
5.2.B Determines optimum ratios of different size aggregates to minimize cement gel requirements.
5.3.A Determines the density of all components in a concrete mix.
5.3.B Calculates the amount of each component by weight to prepare a text mix of designed concrete.
5.4.A Mixes a test batch of designed concrete.
5.4.B Casts test samples according to code requirements.
5.4.C Cures test samples according to code requirements.
5.4.D Tests compression strength of samples according to code requirements.

SAMPLE PERFORMANCE TASKS

- Design a cost effective 4700-psi concrete for use in your local area.
- Design and test a cost effective 6000-psi pumpable concrete for use in your area in the winter.

INTEGRATION LINKAGES

Science, Computer Skills, Research and Writing Skills, Language Arts, Communication Skills, Leadership Skills, Teamwork Skills, Applied Communication, Algebra, Geometry, Secretary's Commission on Achieving Necessary Skills (SCANS), Skills USA-VICA, Associated Builders and Contractors (ABC), Associated General Contractors (AGC), National Center for Construction Education and Research (NCCER), Occupational Safety and Health Administration (OSHA), Environmental Protection Agency, United States Department of Labor, Tennessee Department of Labor and Workforce Development

CONCRETE II

STANDARD 6.0

Students will demonstrate construction site layout requiring radial measurements and curvilinear boundaries.

LEARNING EXPECTATIONS

The student will:

6.1 Locate points on a construction site layout using angular measurements and control points.
6.2 Verify locations by comparing multiple measurements.
6.3 Lay out structural, landscape, and architectural components with curvilinear boundaries.

PERFORMANCE STANDARDS: EVIDENCE STANDARD IS MET

The student:

6.1.A Converts two dimensional coordinates between rectangular and polar coordinates.
6.1.B Locates points on a building site with measurements of one angle and one linear measurement.
6.1.C Locates points on a building site with two angular measurements from control points.
6.2.A Correctly uses multiple linear measurements to establish and verify points on a site layout.
6.2.B Correctly uses multiple combinations of linear and angular measurement to establish and verify points on a site layout.
6.3.A Correctly lays out points on a curved boundary and interpolate between points.
6.3.B Correctly lays out circular segments.
6.3.C Correctly lays out boundaries defined by a sequence of straight lines.

SAMPLE PERFORMANCE TASKS

- Lay out locations and elevations for a multilevel octagonal fountain.
- Lay out a curved access road to be added to school property.
- Lay out the forms for a curved curb to border a garden according to specifications.

INTEGRATION LINKAGES

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CONCRETE II

STANDARD 7.0

Students will design common reinforced concrete structural members.

LEARNING EXPECTATIONS

The student will:

7.1 Design reinforced concrete beams.
7.2 Design one-way reinforced concrete slabs.
7.3 Design reinforced concrete columns with small eccentricity.

PERFORMANCE STANDARDS: EVIDENCE STANDARD IS MET

The student:

7.1.A Correctly designs single and multiple span rectangular beams with uniform loading.
7.1.B Correctly designs single and multiple span rectangular beams with specified non-uniform loading.
7.1.C Correctly designs simple T-beams.
7.2.A Correctly designs single and multiple span one-way slabs.
7.2.B Correctly designs on-grade slabs for local residential construction.
7.3.A Correctly designs short axially loaded columns.
7.3.B Correctly designs columns with both axial and lateral loads.

SAMPLE PERFORMANCE TASKS

- Propose a complete design for a single span bridge beam, including such things as dimensions, concrete mix, reinforcement size and placement, shear reinforcement, etc.
- Propose a complete design for a cantilevered apartment patio slab.
- Design a beam and slab foundation for a single family home in the local area.

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CONCRETE II

STANDARD 8.0

Students will describe basic troubleshooting methodologies for identifying and remedying concrete defects.

LEARNING EXPECTATIONS

The student will:

8.1 Describe and demonstrate a reasoned troubleshooting process.
8.2 Make a checklist of observable problems with reinforcement and forms prior to placement of concrete.
8.3 Identify and describe tests and remedies for problems with wet concrete mixes at the job site.
8.4 Describe possible difficulties and remedies associated with concrete placement and defects that could result.
8.5 Describe observable defects in concrete caused by poor curing practices and possible remedies.

PERFORMANCE STANDARDS: EVIDENCE STANDARD IS MET

The student:

8.1.A Writes an expository paper about the general process of troubleshooting. Provide a reasoned sequence and rank the relative importance of problem identification, research, documentation, causality, remediation, and failure attribution.
8.1.B Develops check lists of formal inspections and tests typical of concrete construction, such as inspections of embedded plumbing and electrical components, slump tests, and concrete sample preparation.
8.2.A Prepares a list of observable defects in concrete form installation.
8.2.B Prepares a list of observable defects in the installation of concrete reinforcement.
8.3.A Describes and demonstrates formal and informal tests applicable to job site inspection of concrete mixes.
8.3.B Describes remedies and action to be taken in the event of failure of a slump test.
8.3.C Describes possible problems and remedies if concrete with an out-of-specification aggregate is delivered to the job site.
8.4.A Describes possible defects and remedies caused by too little or too much action to consolidate concrete.
8.4.B Describes what job site remedies are possible if consolidation difficulties are encountered.
8.5.A Describes observable surface defects caused by improper curing practice.
8.5.B Describes remedial modifications to a curing plan to accommodate extreme weather conditions.

SAMPLE PERFORMANCE TASKS

- Make repeated field trips to a large-scale local construction project to observe concrete construction in progressive stages.
- Invite a guest speaker (e.g., job site foreman) to recount problems and remedies encountered during concrete construction.

- Resolve various problem scenarios with group members role-playing as inspectors, job superintendent, contractor's representative, and project engineer as appropriate.

INTEGRATION LINKAGES

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CONCRETE II

STANDARD 9.0

Students will describe common surface defects and demonstrate ways to repair them.

LEARNING EXPECTATIONS

The student will:

9.1 Identify common concrete defects found in existing structures.

9.2 Describe and demonstrate appropriate methods for repairing defects in concrete structures.

PERFORMANCE STANDARDS: EVIDENCE STANDARD IS MET

The student:

9.1.A Recognizes and identifies defects in concrete.

9.1.B Identifies the causes of concrete deterioration.

9.2.A Selects appropriate repair technique.

9.2.B Prepares the surface and makes the repair.

SAMPLE PERFORMANCE TASKS

- Inspect existing concrete work around your town for defects and identify root cause for any defects found.
- Describe the steps you would take to make the repairs in the above-noted defect.
- Inspect any concrete projects you constructed. Identify and repair, if possible, any defects found.

INTEGRATION LINKAGES

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CONCRETE II

SAMPLING OF AVAILABLE RESOURCES

Books

- *Core Curriculum*, National Center for Construction Education and Research (NCCER). Prentice Hall, Upper Saddle River, NJ; ©2000. Also known as the "Wheels of Learning" materials.
- *Concrete Finishing Level One,* National Center for Construction Education and Research (NCCER). Prentice Hall, Upper Saddle River, NJ; ©1998. Also known as the "Wheels of Learning" materials.
- *Concrete Finishing Level Two*, National Center for Construction Education and Research (NCCER). Prentice Hall, Upper Saddle River, NJ; ©1999. Also known as the "Wheels of Learning" materials.
- *Creating with Concrete: Yard Art, Sculpture and Garden Projects*, Sherri Warner Hunter, Lark Books, 2001.
- *Concrete Construction Handbook,* Joseph A. Dobrowolski, McGraw-Hill Professional Book Group, June 1998.
- *Construction Manual: Concrete and Formwork*, T. W. Love, Craftsman Book Company, October 1979.
- *Concrete, Masonry and Brickwork: A Practical Handbook for the Home Owner and Small Builder*, U. S. Department of the Army, Dover Publications, Inc., August 1999.
- *Concrete Construction and Estimating*, Craig Avery, Craftsman Book Company, November 1983.
- *Foundations and Concrete Work*, Editors of Fine Homebuilding, Taunton Press, Inc., December 2001.
- *Formwork for Concrete Structures*, Robert L. Peurifoy, Garold D. Oberlender, McGraw-Hill Professional Book Group, October 1995.
- *Masonry and Concrete*, C. Beall, McGraw-Hill Professional Book Group, August 2000.
- *Concrete Repair and Maintenance Illustrated: Problem Analysis, Repair Strategy, Techniques*, Peter Emmons and Brandon W. Emmons, A Construction Means Data Group Company, July 1992.

Organizations

- American Concrete Institute International, http://www.aci-int.org/
- American Society for Testing and Materials , http://www.astm.org/
- Building Officials and Code Administrators International, http://www.bocai.org/index.html
- Concrete Masonry Online, National Concrete Masonry Association, www.ncma.org
- International Concrete Repair Institute, http://www.icri.org/
- Portland Cement Association, *http://www.portcement.org/index.asp*
- National Lime Association, *http://www.lime.org/*
- The Concrete Source*, http://www.concretenetwork.com/* See their web page for additional resources: *http://www.concretenetwork.com/links/organizations.htm*